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ABSTRACT

The present study, using a sample of 1,491 grade 10 students from a mid-western province in Canada, examined the validity evidence on the Canadian Tests of Basic Skills. Factor analysis of the 34 micro-skills (content by skill/process classification of items) of the four tests indicated that the Reading Comprehension, Written Expression, and Using Sources of Information micro-skills defined one factor and the Mathematics test defined another. The reliability evidence of this sample was reasonably comparable to the standardization sample. Sex-specific differences in mathematics micro-skills suggest clear targets for instructional mediation and future research. Differential prediction of mathematics cognitive skills confirmed uniqueness of mathematical processes. (Eight tables give analysis results.) (Author)

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Construct Validity and Other Evidence on the Canadian Tests of Basic Skills for a Large Sample of Grade 10 Students

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Running head: CTBS VALIDITY

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Abstract

The present study, using a sample of 1,491 grade 10 students from a mid-western province in Canada examined the validity evidence on the Canadian Tests of Basic Skills. Factor analysis of the 34 micro-skills (content by skill/process classification of items) of the four tests indicated that the Reading Comprehension, Written Expression, and Using Sources of Information micro-skills defined one factor and the Mathematics test defined another. The reliability evidence of this sample was reasonably comparable to the standardization sample. Sex-specific differences in mathematics micro-skills suggest clear targets for instructional mediation and future research. Differential prediction of mathematics cognitive skills confirmed uniqueness of mathematical processes.

Construct Validity and Other Evidence on the Canadian Tests of Basic Skills for a Large Sample of Grade 10 Students

The use of the Canadian Tests of Basic Skills (CTBS) is quite extensive in Canada. Many school jurisdictions use them for a variety of purposes. Also, in many instances, the CTBS have been used in province-wide testing to assess the comparative performance of two or more cohorts of students over a period of time and to compare the performance of students in a province against the normative sample (see Nagy, 1986; Randhawa, 1979, 1986). The school jurisdictions use them for: (a) assessing individual pupil progress; (b) reporting to parents; (c) identifying or confirming at-risk pupils or those for enrichment/gifted programs; (d) placing a new-to-school pupil; (e) assessing instruction effectiveness by group comparisons with the norms; (f) identifying priority programs and professional development needs; (g) identifying learning materials needed either for the classroom or school classroom or school library; and (h) reporting to the community performance of groups of students in various grades or programs (Burnham, 1983; Stennett & Earl, 1983).

Uses such as the above make implicit assumptions regarding the validity evidence for these purposes of the standardized tests. However, to our knowledge other than one study on the speededness of these tests for grade four pupils in a province (Nagy, 1986), no other independent validation evidence is

available. The present paper provides validity evidence on the CTBS from a conception similar to that of Messick (1980) in that "different kinds of inferences from test scores require different kinds of evidence, not different kinds of validity" (p. 1014).

One particular purpose of this study is the understanding of sex differences in achievement in general and in mathematics in particular. The CTBS manual for administrators, supervisors, and counsellors states:

> At the high school level, girls' performance is still markedly superior to that of boys in language skills at all achievement levels, although the magnitude of these differences would appear to decrease slightly across the grades. In mathematics skills the differences favour boys at all achievement levels and increase noticeably from Grade 9 to grade 12. (Canadian Tests of Basic Skills, 1984, p. 82)

Randhawa and Hunt (1987) reported results consistent with the above, based on their large scale testing of Grades 4, 7, and 10 students in 1978. Randhawa (1988) found that Grade 10 females achieved higher than males in language skills and that males performed better than females in mathematics skills. He also reported specific subskill achievement differences in mathematics favouring males. Many other studies (e.g., Ethington & Wolfle, 1984; Hertzog & Carter, 1982; Levine & Ornstein, 1983; Pallas & Alexander, 1983; Smith & Walker, 1988) report similar findings on one or both set of skills.

Another purpose of the present study was the determination of factor structure of the subskills of the four tests. A subskill is defined by the items in a particular content by skill (process) category of each test. The total scores of the test or subtests defined only one factor for grades four and seven samples in our previous study (Randhawa, 1979) using Form 4 of the CTBS. This factor was interpreted as the general achievement factor. The expected separation or independence of mathematics subtests did not occur. It is therefore essential to use component scores of the tests to ascertain whether various cognitive skills define one or more factors for these tests. No such evidence is currently available.

Specifically, the objectives of this paper are as follows:

1. What is the factor structure of the CTBS based on the micro-skill (content by skill/process) grouping of items of the four tests?

2. How does the reliability evidence for this sample compare with the standardization sample?

3. Are there sex differences on the CTBS scores and how do they compare with the differences for the standardization sample?

4. What is the speededness evidence on these tests?

5. Are the pattern and magnitude of prediction of each of the mathematics process clusters by the other two mathematics process clusters and the three CTBS tests, RC, WE, and USI, similar for males and females?

6. In the regression analysis of the total group for each

of the mathematics process cluster as a dependent variable and the same set of predictors as in #4 together with the sex variable, coded as a dummy effect, which equations include sex as a significant and critical variable?

7. If the mathematics process clusters are not included in the predictor variable set in #5, how do the equations and the magnitudes of R^2 compare with those in #5?

Method

Subjects

A random sample of 10% of the grade 10 classrooms in a mid-western province of Canada was selected. The Director/Superintendent of the jurisdiction of the selected classrooms was requested for their participation in the project. As the project was sponsored by the Department of Education of the province, a letter for participation was also sent by a department official. Approximately 95% of the randomly selected classrooms completed the administration of the CTBS battery and returned the answer sheets to the researcher. Usable data on one or more tests of the CTBS for 1,491 grade 10 students were available. Of these, 706 were females and 785 were males.

Instruments

The instrument used was the CTBS, Form 5, Level 16 (King, 1982). This battery consists of four tests, Reading Comprehension (RC), Mathematics (M), Written Expression (WE), and Using Sources of Information (USI). The number of items for grade 10 students in these tests is respectively 62, 48, 62, and 67. It must be noted that the CTBS are based on the Iowa Tests of Basic Skills.

Procedure

The test administration was carried out between October 15 and November 15, 1985 by classroom teachers according to a prescribed schedule. On day one, in the morning, the Reading Comprehension was administered and in the afternoon, the

Mathematics test was given. On day two, in the morning and in the afternoon respectively, Written Expression and Using Sources of Information were administered. Teachers administering the test were instructed to follow strictly the instructions and time guidelines according to the test manual.

After all the tests were administered to a class, the answer sheets were forwarded to the school board offices. The school board office personnel, after they had received all the answer sheets from the various classrooms selected, sent the answer sheets to the researcher.

Analysis and Results

Reliability, regression, factor analysis, as well as multivariate and univariate analysis of variance procedures from the SPSS^X (1986) were used to analyze the item, micro-skill, and raw score test data.

Reliability

The reliability data for the provincial sample and the national standardization sample are provided in Table 1. As can be seen, the provincial means of the RC, M, WE, and USI were, respectively, 40.8, 27.7, 35.6, and 48.6. The corresponding means for the standardization sample were, respectively, 39.5, 26.8, 34.0, and 46.7. These results suggest that the provincial sample achieved significantly better ($p \leq .05$) than the standardization sample on the four tests. The variability of our sample, as expected, was somewhat lower than the standardization sample on all the tests. Similarly, alpha reliability estimates of the tests were slightly lower than that

for the standardization sample. The range was 0.85 to 0.90 for our sample as compared with the range of 0.87 to 0.92 for the standardization sample. The standard errors of estimate were almost comparable, with the largest discrepancy being 0.20.

Insert Table 1 about here.

Construct Validity

Micro-skill cluster scores of items were obtained for each subject by adding the obtained score on each item in a content by skill (process) cluster. These clusters, in all cases except where there were fewer than three items in a cluster, were obtained according to the classification of items for each test in the test manual. For those cases where there were less than three items, items in different content categories but in the same process category were combined. These cluster scores were used in a maximum likelihood factor analysis to determine whether these clusters spanned one or more cognitive constructs. As it has already been known that males and females differ on these tests (King, 1982), it was hypothesized that the clusters corresponding to RC, WE, and USI would define one factor and that the M clusters would define another factor.

Initial principal components of the correlation matrix produced four eigenvalues larger than one. The corresponding maximum likelihood factor solution followed by a varimax rotation resulted in four parsimonious factors such that the cluster scores of each test produced a unique factor. Table 2

gives the results of the varimax solution of the four-factor maximum likelihood factor procedure. These four factors accounted for 39.7% of the total variance in the 34 variables. However, only two of the final eigenvalues corresponding to these factors were greater than one. This fact and an examination of the plot of the initial eigenvalues, using Cattell's (1966) scree test, suggested the appropriateness of two factor solution. Hence, another maximum likelihood factor solution with two common factors was carried out and the resultant matrix was rotated to the varimax criterion. The results of the varimax rotation for this extraction are given in Table 3. The first of these two factors, as hypothesized, was defined by the micro-skills of the RC, WE, and USI tests. The second factor was significantly and totally defined by the M test micro-skills. These two factors accounted for 36% of the total variance. This might suggest that the underlying cognitive processes for the RC, WE, and USI tests are similar but distinct from the M test. Perhaps, because of these different cognitive demands, females excel in RC, WE, and USI, and males excel in the M test (see King, 1982; Randhawa, 1988).

Insert Tables 2 and 3 about here.

Speededness

The CTBS manual for administrators, supervisors, and counsellors, states that the CTBS Multilevel Batteries are primarily "power" tests; that is the time allowed for completing

the tests are sufficient enough so that the majority of examinees can finish the tests in the allotted time. For our sample, it was found that the CTBS tests were indeed power tests. The largest number of examinees not finishing the last two items of the Reading Comprehension test was 14%. The last third and fourth items, items 81 and 82, were not attempted by 13% of the examinees. On the Mathematics test the percentage of examinees not attempting the last three items, 62, 63, and 64, was respectively 9, 9, and 10. Only 5% of the examinees did not attempt the last two items of the Written Expression test. By far the largest percentage of examinees (96%) attempting the last four items was in the Using Sources of Information test.

Sex Differences

Manova and anova analyses were carried out for the four total test raw scores. Sex was used as the independent variable. The raw score means of males and females on these tests are given in Table 4. In this table are also provided the difference of the female mean over the male mean in terms of the standard scores on each test for our sample and the standardization sample at the median. The multivariate exact F-test was significant [F (4, 1486) = 61.1, $p \leq .05$] and the corresponding univariate F-tests for 1, 1489 degrees of freedom were also significant. An examination of the differences suggests that these results confirmed both the results reported for the standardization sample and those reported in the literature (Maccoby & Jacklin, 1974; Randhawa, 1988; Randhawa & Hunt, 1987). However, it should be noted that the observed

difference on M is less than that for the standardization sample. On the other hand, differences on RC, WE, and USI for our sample are larger than those for the standardization sample.

Insert Table 4 about here.

Regression of Mathematics Components

The M test consists of three process or cognitive skills, namely computation, concepts, and problem solving. It was hypothesized that for the prediction of a particular process skill the other two process skills would contribute substantially more than the RC, WE, and USI. Therefore, three separate regression analyses, with each mathematics process skill as the dependent variable and the other two process skills and the three other tests as predictor variables, were made for the males' and females' data.

The correlation matrices for the males and females for the six variables are given in Table 5. Appended to these matrices are the means and standard deviations of the variables. The three pairs of correlations among the three mathematics cognitive skills for the males, pair by pair, are higher than for the females. Whereas, the correlations of the other three tests, pair by pair, are higher for the females than for the males.

Insert Table 5 about here.

In Table 6 are presented the results of the step-wise regression analyses for the males and females. At each step in the regression analysis, a variable was considered making a significant contribution if it accounted for at least 1% of the variance in the dependent variable and also if its increased contribution to R^2 was significant at the .05 level. As expected, for the prediction of each process skill, the other two figured prominently in each set of analyses. Each equation consisted of three predictor variables, one of the other three tests and two mathematics cognitive skills. The USI entered in four of the equations, two each for males and females. The RC entered in the second step for the females in predicting Problem Solving; whereas, WE entered in the third step for males when predicting Mathematics Computation cognitive skill. The magnitudes of R^2 were systematically higher for the males than for the females.

Insert Table 6 about here.

Another set of three regression analyses using the total sample was made. In these analyses, as in the previous ones, each mathematics process component score was used as the dependent variable and the other mathematics component scores, the three total scores, and sex coded as a dummy effect were entered as predictor variables in three separate step-wise regression analyses. The results of these analyses are presented in Table 7. The R^2 for the Computation, Concepts, and

Problem Solving was respectively .44, .61, and .60. Only in the regression equation for the Problem Solving Component did the Sex variable contribute a critical and significant amount of predicted variance. This analysis seems to eliminate the contradiction in results reported by Randhawa (1988) as compared with those of Randhawa and Hunt (1987), in both of which an analysis of variance approach was used.

Insert Table 7 about here.

Another set of regression analyses was performed to determine the role of the mathematics component scores in the prediction of mathematics component ability. To determine this role, it would be desirable to remove the mathematics component scores from the predictor set of variables in each case. The results of these analyses are available in Table 8. The prediction equation of the Computation component included USI, WE, and Sex and it accounted for 31.4% of the variance; whereas the prediction equation involving the other two mathematics components as predictors, given in Table 7, included both the Concepts and Problem Solving components which accounted for 42.2% of the variance and the addition of WE increased the R^2 to 0.438, indicating an increase of 1.8% in the predicted variance. Sex, RC, and USI variables did not enter the regression in this case.

Insert Table 8 about here.

The prediction equation for the Concepts component, as shown in Table 8, consisted of in order USI, WE, Sex, and RC with an R^2 of 0.461. On the other hand, the previous equation (Table 7) for this component included Problem Solving, USI, and Computation and the associated R^2 was 0.611.

Again, for the prediction of the Problem Solving component all four predictors entered the regression equation and the R^2 = 0.450 was obtained (Table 8). This is in contrast to the R^2 = 0.604, with the predictor variables in order being Concepts, Computation, RC, and Sex in the equation (Table 7).

In summary, it is clear that mathematics ability is built substantially on an acquisitional schema consisting of mathematical components. Sex differentiation is paramount, even in the presence of mathematical computation and concepts, when solving problems.

Conclusion and Discussion

The present study provides additional and independent construct validity evidence for the CTBS. Also, it extends the evidence to cognitive process analysis and pinpoints the source of sex differences in mathematics achievement. A componential analysis of sex differences, as done for mathematics in the present study, should provide educators and researchers targets

for reducing sex specific achievement discrepancy in all the components of these and other tests.

The construct validity procedure employed in the present study was the factor analysis of subskills of the four tests. As pointed out in the procedures for the study, all subskills of the CTBS tests for Grade 10 do not have at least three items. Therefore, it was deemed desireable to go across the content categories of the tests to combine items so that the final subskills were comprised of a minimum of three items. By doing this, both the replication and the concomitant moderate reliability criteria for each subskill was thus ensured. Perhaps the test makers in the future in multilevel batteries such as the CTBS should attempt to include a minimum of three items in each subskill of a test for each level. This may in some instances add to the length of the test, but a decrease in the number of items in another subskill of the same test with a substantial number of items could compensate for this increase. This strategy could enhance the utility of subskills for instructional diagnosis and intervention based on a reasonably reliable evidence. Afterall, teachers are better able to focus on a singular contextual strategy than a multicontextual common strategy or multiple strategies for a common content.

Our two-factor solution suggests that mathematics skills are somewhat independent, in spite of the apparent statistical artifacts, of skills involved in reading, written expression, and using various sources of graphical and tabular data. However, the same pattern of two factors for both males and

females was observed, though these results are not included in the present paper, which suggests that the cognitive characterization of subskills of the CTBS tests was similar for both groups. Then how do we account for achievement differences in males' and females' performance on these tests? Several reasons, including strategic knowledge specific to the domain of engagement, perceived value of the knowledge domain in current and future endeavors, cognitive schema, and representational and transformational forms experienced and practiced in context, could be advanced (Randhawa, 1985; Sternberg, 1982).

More important nevertheless is the finding that in the regression analysis of mathematics process components it was found that the other mathematics components were more critical in performance than the other test scores. This again underscores the content and context specific awareness and strategies as the crucial determinant of mathematics achievement. People get good at those things which they experience with interest and purpose (Sternberg, 1985). Hence academic performance is no exception in this regard. However, it is still not clear how generalization and transfer of domain-specific strategic and procedural knowledge occurs. This offers an exciting opportunity and challenge for future research.

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Table 1

Reliability and Other Statistics for the Four Tests of the Canadian Tests of Basic Skills, High School, Multilevel Edition, Form 5, Level 16 for the Grade 10 Provincial Sample and the Standardization Sample

Statistic	Provincial (N=1491)				Standardization (N=2369)			
	R	M	WE	USI	R	M	WE	USI
1. Mean	40.8	27.7	35.6	48.6	39.5	26.8	34.0	46.7
2. Standard Deviation	9.30	8.00	9.00	10.1	9.90	8.40	9.20	10.8
3. Mean Item Difficulty	0.659	0.577	0.575	0.726	0.637	0.558	0.548	0.697
4. Minimum Difficulty	0.237	0.239	0.272	0.198	N/A	N/A	N/A	N/A
5. Maximum Difficulty	0.971	0.902	0.907	0.943	N/A	N/A	N/A	N/A
6. Alpha Reliability	0.875	0.860	0.849	0.901	0.90[a]	0.88	0.87	0.92
7. Standardized Alpha	0.877	0.860	0.850	0.909	N/A	N/A	N/A	N/A
8. Standard Error of Measurement	3.30	3.00	3.50	3.00	3.10	2.90	3.40	3.10

[a] These are KR-20 estimates

Table 2

Varimax Factor Loadings of the Micro-Skills of the Four CTBS (Form 5, Level 16) Tests for the 1985 Provincial Sample (N=1491) for the Four Factor Maximum Likelihood Solution

Variable	Factor				h^2
	1	2	3	4	
1. Equivalent Forms & Order Concepts	0.64	0.17	0.13	0.14	0.47
2. Common Applications Problem Solving	0.61	0.15	0.29	0.21	0.53
3. Common Applications & Algebra Concepts	0.59	0.19	0.14	0.13	0.42
4. Basic Mathematical Principles Concepts	0.57	0.25	0.15	0.17	0.43
5. Operations, Geometry & Measurement Computation	0.53	0.23	0.15	0.18	0.38
6. Equivalent Forms & Order & Algebra Problem Solving	0.50	0.16	0.14	0.10	0.30
7. Geometry & Measurement Concepts	0.48	0.20	0.12	0.14	0.31
8. Geometry & Measurement Problem Solving	0.47	0.14	0.08	0.14	0.27
9. Statistics, Graphs & Tables Problem Solving	0.46	0.13	0.14	0.11	0.26
10. Common Applications & Algebra Computation	0.45	0.15	0.14	0.09	0.26
11. Inferences From Graphs & Tables	0.40	0.20	0.31	0.28	0.38
12. Statistics, Graphs & Tables Concepts	0.39	0.15	0.21	0.24	0.28

Table 2 (Contd.)

Varimax Factor Loadings of the Micro-Skills of the Four CTBS (Form 5, Level 16) Tests for the 1985 Provincial Sample (N=1491) for the Four Factor Maximum Likelihood Solution

Variable	Factor				h^2
	1	2	3	4	
13. Analysis, Synthesis & Evaluation of Grammar & Usage	0.18	0.59	0.18	0.14	0.43
14. Grammar & Usage Comprehension & Application	0.21	0.53	0.23	0.21	0.42
15. Punctuation Comprehension & Application	0.21	0.52	0.21	0.22	0.41
16. Evaluation of Organization	0.22	0.51	0.25	0.26	0.44
17. Analysis & Synthesis of Organization	0.26	0.45	0.31	0.22	0.41
18. Spelling & Capitalization Comprehension & Application	0.19	0.35	0.19	0.16	0.22
19. Spelling & Capitalization Factual Identification	0.18	0.28	0.09	0.09	0.13
20. Factual Identification, Comprehension & Application of Forms	0.16	0.24	0.11	0.11	0.11
21. Comprehension & Application of Organization	0.19	0.22	0.12	0.09	0.11
22. Textbook Fact	0.28	0.32	0.61	0.25	0.61
23. Textbook Inference	0.25	0.36	0.59	0.26	0.61
24. Everyday Inference	0.27	0.30	0.56	0.26	0.54
25. Everyday Fact	0.26	0.29	0.53	0.31	0.53
26. Textbook Generalization	0.19	0.20	0.51	0.12	0.36
27. Everyday Generalization	0.22	0.27	0.49	0.28	0.43

Table 2 (Contd.)

Varimax Factor Loadings of the Micro-Skills of the Four CTBS (Form 5, Level 16) Tests for the 1985 Provincial Sample (N=1491) for the Four Factor Maximum Likelihood Solution

Variable	Factor				h^2
	1	2	3	4	
28. Application of Reference Material	0.21	0.39	0.27	0.61	0.64
29. Identification from Knowledge & Use of Reference Material	0.17	0.34	0.17	0.59	0.53
30. Identification from Reading Maps, Graphs & Tables	0.38	0.17	0.26	0.59	0.58
31. Comprehension of Reference Materials	0.28	0.40	0.20	0.54	0.58
32. Comprehension of Graphical & Tubular Materials	0.44	0.17	0.24	0.46	0.48
33. Map Reading Comprehension	0.40	0.15	0.26	0.43	0.43
34. Inferences From Maps & Reading	0.12	0.18	0.19	0.37	0.42
Eigenvalue	11.05	1.27	0.63	0.56	13.51
% Variance	32.50	3.70	1.80	1.60	39.70

Table 3

Varimax Factor Loadings of the Micro-Skills of the Four CTBS (Form 5, Level 16) Tests for the 1985 Provincial Sample (N=1491) for the Two Factor Maximum Likelihood Solution

Variable	Factor		h^2
	1	2	
1. Application of Reference Material	0.69	0.28	0.53
2. Textbook Inference	0.68	0.29	0.55
3. Textbook Fact	0.66	0.31	0.27
4. Everyday Fact	0.64	0.29	0.49
5. Everyday Inference	0.63	0.30	0.49
6. Comprehension of Reference Materials	0.62	0.34	0.41
7. Identification from Knowledge & Use of Reference Material	0.60	0.24	0.38
8. Everyday Generalization	0.59	0.24	0.47
9. Evaluation of Organization	0.58	0.25	0.52
10. Analysis & Synthesis of Organization	0.56	0.28	0.25
11. Grammar & Usage Comprehension & Application	0.55	0.23	0.42
12. Identification from Reading Maps, Graphs & Tables	0.55	0.42	0.30
13. Punctuation Comprehension & Application	0.54	0.23	0.30
14. Analysis, Synthesis & Evaluation of Grammar & Usage	0.51	0.21	0.27

Table 3 (Contd.)

Varimax Factor Loadings of the Micro-Skills of the Four CTBS (Form 5, Level 16) Tests for the 1985 Provincial Sample (N=1491) for the Two Factor Maximum Likelihood Solution

Variable	Factor		h^2
	1	2	
15. Textbook Generalization	0.48	0.21	0.28
16. Comprehension of Graphical & Tubular Materials	0.47	0.47	0.26
17. Map Reading Comprehension	0.46	0.43	0.42
18. Inferences From Graphs & Tables	0.44	0.42	0.10
19. Inferences From Maps & Reading	0.42	0.14	0.21
20. Spelling & Capitalization Comprehension & Application	0.40	0.21	0.35
21. Factual Identification, Comprehension & Application of Forms	0.26	0.17	0.36
22. Spelling & Capitalization Factual Identification	0.26	0.19	0.10
23. Comprehension & Application of Organization	0.24	0.19	0.10
24. Equivalent Forms & Order Concepts	0.22	0.65	0.30
25. Common Applications Problem Solving	0.35	0.63	0.39
26. Common Applications & Algebra Concepts	0.23	0.60	0.40
27. Basic Mathematical Principles Concepts	0.29	0.58	0.48

Table 3 (Contd.)

Varimax Factor Loadings of the Micro-Skills of the Four CTBS (Form 5, Level 16) Tests for the 1985 Provincial Sample (N=1491) for the Two Factor Maximum Likelihood Solution

Variable	Factor 1	Factor 2	h^2
28. Operations, Geometry & Measurement Computation	0.29	0.54	0.42
29. Equivalent Forms & Order & Algebra Problem Solving	0.20	0.51	0.39
30. Geometry & Measurement Concepts	0.24	0.50	0.44
31. Geometry & Measurement Problem Solving	0.18	0.49	0.51
32. Statistics, Graphs & Tables Problem Solving	0.19	0.47	0.56
33. Common Applications & Algebra Computation	0.20	0.46	0.19
34. Statistics, Graphs & Tables Concepts	0.32	0.42	0.37
Eigenvalue	11.03	1.23	12.26
% Variance	32.40	3.60	36.00

Table 4

Raw Score Means of the Four CTBS Tests for Males and Females and the Standard Score Female-Male Difference for the Provincial and Standardization Sample

Test	Raw Score Mean		Standard Score Difference (F-M)	
	Females (N=706)	Males (N=785)	Provincial	Standardization
Reading	42.40*	39.61	4.2	1.4
Mathematics	27.20*	28.14	-1.9	-4.4
Written Expression	38.10*	33.42	10.4	8.3
Using Sources of Information	49.94*	47.76	4.8	2.6

*Significant at the 0.05 level.

Table 5

Correlation Matrices[1] of Grade 10 Males (N=785) and Females (N=706) for the three Mathematics Process Skills, and Reading Comprehension, Written Expression, and Using Sources of Information Tests of the Canadian Tests of Basic Skills for the Provincial 1985 Sample

Variable	1	2	3	4	5	6	$\bar{x}$	s
1. Math Computation	-	616	628	477	476	505	5.8	1.8
2. Math Cocepts	592	-	756	582	566	626	11.6	3.9
3. Math Problem Solving	572	692	-	586	543	620	10.7	3.5
4. Reading Comprehension	493	578	605	-	662	712	39.6	9.6
5. Written Expression	540	623	608	726	-	667	33.4	8.7
6. Using Sources of Information	554	659	621	725	745	-	47.5	10.9
$\bar{x}$	5.7	11.4	10.1	42.2	38.1	49.9		
s	1.7	3.8	3.2	8.7	8.8	8.9		

[1] Males' correlations are above and females' are below the diagonal, the values are rounded off to three decimal places, and the decimal is omitted.

Table 6

Regression Analysis of the Mathematics Process Skills on Process Skills and other CTBS Tests for Males and Females of the Grade 10 Provincial 1985 Sample

Group	Dependent Variable	Step-Wise Independent Variable Entered	Obtained R^2
Female	Math Computation	Math Concepts	0.351
		Math Problem Solving	0.401
		Using Sources of Information	0.426
	Math Concepts	Math Problem Solving	0.479
		Using Sources of Information	0.565
		Math Computation	0.589
	Math Problem Solving	Math Concepts	0.479
		Reading Comprehension	0.542
		Math Computation	0.563
Male	Math Computation	Math Problem Solving	0.395
		Math Concepts	0.441
		Written Expression	0.452
	Math Concepts	Math Problem Solving	0.572
		Using Sources of Information	0.612
		Math Computation	0.633
	Math Problem Solving	Math Concepts	0.572
		Math Computation	0.614
		Using Sources of Information	0.637

Table 7

Regression Analysis on Process Skills, CTBS Tests, and Sex Coded as a Dummy Effect for the Total Grade 10 Provincial 1985 Sample

Dependent Variable	Step-Wise Independent Variable Entered	Obtained R^2
Math Computation	Math Concepts	0.367
	Math Problem Solving	0.423
	Written Expression	0.423
Math Concepts	Math Problem Solving	0.527
	Using Sources of Information	0.586
	Math Computation	0.611
Math Problem Solving	Math Concepts	0.527
	Math Computation	0.569
	Reading	0.593
	Sex	0.604

Table 8

Regression Analysis on CTBS Tests, and Sex Coded as a Dummy Effect for the Total Grade 10 Provincial 1985 Sample

Dependent Variable	Step-Wise Independent Variable Entered	Obtained R^2
Math Computation	Using Sources of Information	0.266
	Written Expression	0.294
	Sex	0.314
Math Concepts	Using Sources of Information	0.397
	Written Expression	0.314
	Sex	0.450
	Reading	0.461
Math Problem Solving	Using Sources of Information	0.360
	Reading	0.401
	Sex	0.435
	Written Expression	0.450